

1 **Remarks/Arguments**

2 This amendment is submitted in response to the Office action dated July 25, 2005.
3 Applicant encloses a request for extension of time to and including November 25, 2005 by
4 which to respond along with the required fee for a small entity in the amount of \$60. The
5 application now has four independent claims (i.e., claims 5,6,8 and 15), and the fee of \$100
6 for the fourth independent claim is enclosed.

7 In response to the rejections of claims 5 and 7 under 35 USC 112, applicant has
8 amended both claim 5 and 7 to overcome the rejection.

9 In response to the rejection of claims 1-7 and 13-15, in view of the Lin et al prior art,
10 applicant has made the following claim amendments, cancellations and submission of new
11 claims:

12 Claims 1-4, 9-10 and 12-14 have been canceled.

13 Claims 16, 17 and 18 are added to the application, carrying forward the subject matter
14 of originally filed claims 9, 10 and 12.

15 The only claims remaining in the application are claims 5-8, 11 and 15-18.

16 The undersigned notes the allowance of the subject matter of claim 11. Claim 11
17 remains in the application as dependent upon claim 8 while applicant seeks the allowance of
18 claim 8.

19 Concerning amended claim 5, the Lin reference simply does not teach or suggest a
20 reflection waveplate. Applicant has reviewed the Lin reference carefully and the references
21 to the various portions of Lin made by the Examiner; Lin simply does not teach or suggest the
22 use of a photonic crystal as a reflection waveplate.

23 With respect to claim 6, applicant has carefully reviewed the Lin reference and Lin does
24 reference a beamsplitter - but not a polarizing beamsplitter. Although all polarizing
25 beamsplitters are types of beamsplitters, the converse is not necessarily true. Lin makes no
26 mention that Fig. 6C of his patent is a polarizing beamsplitter or a polarization splitter based

1 on the band gaps of the photonic crystal. Claim 6 is therefore patentable.

2 Claim 7 is patentable based on the patentable subject matter of claim 5.

3 With respect to claim 8, applicant has reviewed the Lin reference and that reference
4 does not teach or suggest any treatment of optical nonlinearities to which claim 8 is
5 concerned. The Examiner in an earlier Office action referenced the Byer prior art relative to
6 claim 8 and the concept of phasematching. However, applicant has carefully reviewed the
7 Byer reference and, although the concept of phasematching is well known in the prior art, the
8 Byer reference was not utilizing photonic crystals to obtain phasematching. The difference is
9 critical. The structures used by Byer in achieving phasematching do not have the properties
10 of photonic crystals. The present application adds some nonlinearity to a photonic crystal so
11 that the linear optical properties of the crystal can be utilized to enhance a nonlinear affect.
12 The Byer reference describes the structure in which the periodic variations of the crystal are
13 fundamentally nonlinear in nature. Furthermore, the phasematching as described in Byer
14 does not rely on any artificial or intrinsic birefringence of the structure.

15 It is significant to note that the present invention utilizes for the first time photonic
16 crystals to achieve phasematching in nonlinear optical processes. Neither the Lin nor the Byer
17 prior art references teach such a technique. In the Byer patent, Figs. 1 and 2 show apparatus
18 related to nonlinear frequency conversion. However, the apparatus described and shown in
19 the present disclosure and figures is quite different. In particular, the Byer patent shows light
20 from a laser diode being guided through an optical fiber into a waveguide within a ferroelectric
21 crystalline body. The ferroelectric crystalline body has a periodically varying domain
22 orientation which allows phasematching to be achieved through a process known as quasi-
23 phasematching. This is completely different from the apparatus shown in the figures in the
24 present application as those figures pertain to nonlinear frequency conversion. The only
25 similarity is the goal of achieving phasematching in a nonlinear optical process. This in and
26 of itself is nothing unusual, as there are many known textbooks and patents describing

1 different methods of phasematching. The present technique of achieving phasematching, as
2 described in claim 8 as currently amended, is entirely different in that 1) the technique does
3 not rely on quasi-phasematching; 2) phasematching is based on the polarization-dependent
4 dispersive properties of linear photonic crystals which incorporate nonlinearity only to provide
5 the conversion of energy between different frequencies; and 3) they do not rely on ferroelectric
6 materials or any periodic poling of different domains. Fig. 2 in the Byer patent also shows light
7 being directed through a periodically poled body.

8 Applicant has reviewed all of the references cited and the comments above are true
9 with respect to those other patents as well. For those reasons, the undersigned submits that
10 claim 8, currently amended, is patentable over all of the references of record. The subject
11 matter of original claims 9, 10 and 12 has been carried forward into new claims 16, 17 and 18.
12 The subject matter of new claims 16, 17 and 18 is patentable based upon the patentable
13 subject matter of claim 8.

14 The subject matter of claim 11 has previously been found patentable. Therefore, no
15 comments are made herein regarding claim 11.

16 Claims 13 and 14 are canceled.

17 With respect to claim 15, applicant has carefully reviewed the Lin reference and has
18 found that Lin does not discuss anything about creating a time delay for an optical pulse,
19 which is precisely what is addressed by claim 15. Rather, Lin teaches only the retardation of
20 the phase velocity of different polarizations. This has nothing to do with controlling the group
21 velocity of a beam as described in the present invention. Lin only describes how a general
22 waveplate works, a concept well known in the field. For the above reasons, the undersigned
23 submits that claims 5-8, 11 and 15-18 are allowable for the reasons stated above.

24 Favorable action is requested.

1 Please take note of the attached change of correspondence address.

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3 Respectfully submitted,

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19 I hereby certify that this correspondence is
20 being deposited with the United States Postal
21 Service as first class mail in an envelope
22 addressed to: Mail Stop Fee Amendment

23 _____, Commissioner for Patents,
24 P.O. Box 1450, Alexandria, VA 22313-1450,
25 on November 23, 2005
26 Reg. No. 24,982 of Eckhoff & Hoppe

Bruce H. Johnsonbaugh
Signature

Nov. 23, 2005
Date